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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Mario Saggio

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EXAMINER

IM, JUNGHWA M

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 01/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/053,865

Applicant(s)

SAGGIO ET AL.

Examiner

Junghwa M. Im

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 08 October 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-4 and 6-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 6-21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 6-11, 13-16 and 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silber et al. (DE 198 20 734), hereinafter Silber and Werner et al. (US 6184545), hereinafter Werner.

Regarding claims 1, 3, 8 and 9, Figure 6 of Silber shows a Schottky barrier diode comprising:

a substrate region (3) of a first conductivity type ( $n^+$ ) formed underneath a semiconductor material layer (2) of the same conductivity type (n);

a metal layer (1); and

at least two doped regions (5 and 56) of a second conductive type (p) formed in said semiconductor material layer, each one of said doped regions being disposed under said metal layer and being separated from the other doped region and said substrate region by portions of said semiconductor layer.

Silber shows substantially the entire claimed structure except "said doped regions are optimally doped to equalize the charge in said semiconductor material layer so that the electric field upon the entire volume of a drain region of said semiconductor material layer is constant and also equal to a critical electric field of said semiconductor material layer and at least one of the doped regions is in an edge area of said Schottky barrier

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diode.” Werner discloses the a Schottky barrier diode wherein the corresponding doped regions (8) are doped to equalize the charge in the semiconductor layer (9) so that the electric field upon the entire volume of the doped region is constant and also equal to a critical electric field of a drain region (4) said semiconductor material layer (col. 1, line 64 – col. 2, line 3 and col. 4 lines 16-54).

It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Werner into the device of Silber in order to have the doped regions doped to equalize the charge in the semiconductor material layer so that the electric field upon the entire volume of the semiconductor material layer is constant and equal to the critical electric field of the semiconductor material since such a breakdown voltage of the device can be adjusted through a suitable doping concentration in the doped region as taught by Werner through the specification.

Also, note that charges are read as mobile charge carriers which are “equalized” because the reference teaches that there are no positive carriers and no negative carriers. Additionally, Werner shows the electric field upon the entire volume of the semiconductor material layer is equal to the critical electric field of the silicon in terms of a breakdown charge of the semiconductor (col.1, line 67-col.2, line3).

Furthermore, note that a limitation of “the doped regions are optimally doped to equalize the charge in the semiconductor material layer so that the electric field upon the entire volume of a drain region of the semiconductor material layer is constant and equal to a critical electric field of the said semiconductor material layer” is an operating function of device rather than a structure of device and is not a structurally distinguishing. Claims directed to apparatus must be distinguished from the prior art in

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terms of structure rather than function. *In re Danly*, 263 F.2d 844, 847, 120 USPQ 528, 531 (CCPA 1959).

“[A]pparatus claims cover what a device is, not what a device does.”(emphasis in original) *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1469, 15 USPQ2d 1525, 1528 (Fed. Cir. 1990).

Regarding claim 2, Silber shows that said semiconductor material layer comprises a first resistivity value, and said doped regions each comprise a second resistivity value, wherein said second resistivity value is higher than said first resistivity value through disclosing that the doping concentration of p region is higher than the one in the semiconductor layer.

Regarding claims 4 and 6, Silber shows said doped regions further comprise the doped regions further comprise heavily doped body regions (5) having the same conductivity type of said doped regions.

Regarding claim 7, Silber shows said semiconductor material layer comprises a resistivity value lower than five Ohm-cm for a breakdown voltage higher than 200V (col. 3, lines 38-51).

In addition, it would have been obvious to one of ordinary skill in the art at the time of the invention made to have a recited resistivity value for a range of the specified breakdown voltage for better reliability, since it would have been held that general conditions of a claim are

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disclosed in the prior art by showing how to control the breakdown voltage through limiting the maximum depth of the depletion region, discovering the optimum or workable ranges involves only in routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claims 10 and 11, Silber shows said Schottky barrier diode is operational at a voltage of 500V/600V (col. 3, lines 38-51).

Also, note it would have been obvious to one of ordinary skill in the art at the time of the invention to have an operational voltage recited in the instant invention to accommodate a high current operation, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 13, Werner shows least one of the doped regions is in the active area of the diode and at least one of the doped region is in an edge of the active area of the diode.

Regarding claims 14 and 18, Figure 6 of Silber shows A Schottky barrier diode comprising:

----- a-substrate-region-(3)-of-a first-conductivity-type-(n)-formed-underneath-a -----

semiconductor material layer (2) of the same conductivity type (n);

a metal layer (1); and

at least two doped regions (5, 56) of a second conductive type (p) formed in said semiconductor material layer, each one of said doped regions being separated from the other doped region and said substrate region by portions.

Figure 6 of Silber shows the most aspect of the instant invention except “at least one of the doped regions is in an active area of said Schottky barrier diode and at least

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one of the doped regions is in an edge area of said Schottky barrier diode.” Figure 2 of Werner shows a Schottky barrier diode wherein at least one of the doped regions is in an active area and at least one of the doped regions is in an edge area of the diode.

It would have been obvious to one of ordinary skill in the art at the time of the invention

to incorporate the teachings of Werner into the device of Silber in order to have at least one of the doped regions is in an edge area of the diode, resulting in a guard ring structure for device protection (col. 5, lines 6-14).

The subject matters regarding claims 15-16 and 19-20 have been discussed in claims 7 and 11.

Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Silber and Werner as applied to claims 1 above, and further in view of Readdie et al. (US 5254869), hereinafter Readdie.

Regarding claim 12, the combined teachings of Silber and Werner shows the substantially the entire claimed structure except a silicide layer over the semiconductor material layer. Fig. 4 of Readdie shows a Schottky diode wherein a silicide layer (401a) formed over the semiconductor layer (101) and below the metal layer (105a). It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the teachings of Readdie into the device of Silber in order to have a silicide layer over the semiconductor layer and below the metal layer so as to reduce the diffusion of the metal into the semiconductor (Abstract).

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Claims 17 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silber and Werner as applied to claims 14 and 18 above, and further in view of Readdie et al. (US 5254869), hereinafter Readdie.

The subject matter regarding claims 17 and 21 has been discussed above in claim 12.

### *Response to Arguments*

Applicant's arguments filed October 8, 2004 have been fully considered but they are not persuasive. The rejection stands, modified only to accommodate the amendments made to the claims by Applicant. New rejections are made in response to Applicant amended claims.

As discussed in detail in the Office action above, it is pointed out that a functional recitation of "the doped regions are optimally doped to equalize the charge in the semiconductor material layer so that the electric field upon the entire volume of a drain region of the semiconductor material layer is constant and equal to a critical electric field of the said semiconductor material layer" is an operating function of device rather than a structure of device and is not a structurally distinguishing. Furthermore, the electrical field upon the volume of the drain region (26; an epitaxial region in Fig. 6) of Silber is constant and equal to an electrical field of the semiconductor material layer with the teachings of Werner incorporated.

The Applicant further argues that "Silber and Werner appear to teach that the edge area is the same conductive type as the semiconductor area." Examiner disagrees.



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Fig. 2 of Werner, in particular shows that the two doped regions (8) on the both sides. In addition, it is pointed out that the instant invention does not disclose that “an edge area” conveys a particular meaning.

### *Conclusion*

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

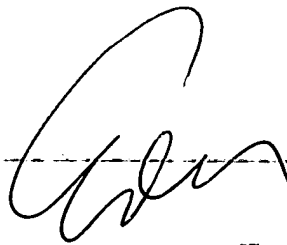
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junghwa M. Im whose telephone number is (571) 272-1655. The examiner can normally be reached on MON.-FRI. 8:30AM-5:00PM.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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